INITIAL REPORT

W9132T-04-R-BAA1

ReliOn, Inc.

Fuel Cells for Homeland Security
U.S. Border Patrol Application

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY04

Site 1—U.S. Border Patrol Repeater Station, Mica Peak, Washington
Site 2—U.S. Border Patrol Sector Headquarters, Spokane, Washington

July 18, 2005

Executive Summary

The security of our borders is a critical aspect of Homeland Security for the United States. Clearly, it is an overwhelming challenge to monitor and protect the vast regions that form the U.S. borders, and this challenge is multiplied by the limited utility grid reliability in these remote locations. Under this project, ReliOn is studying and quantifying the impact of its modular fuel cell-based backup power solutions on the network reliability of the Department of Homeland Security, U.S. Border Patrol. The project will include data gathering on the availability, reliability, operating characteristics and costs of implementing the ReliOn proton exchange membrane (PEM) fuel cell solution to provide backup power at two critical communication site supporting the security of the northwestern U.S. border. ReliOn will manufacture, integrate and install fuel cell backup power solutions at a U.S. Border Patrol communications site on Mica Peak near Spokane, Washington and at the Border Patrol Sector Headquarters Station in Spokane. The Border Patrol operates critical radio base station equipment as well as microwave repeaters at these sites. Specific data to be analyzed will consist of: start-up capabilities, availability during outages, shut-down capabilities, system efficiencies, load following, maintenance operations, and effects of environmental conditions.

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1.0 Descriptive Title

Field testing the performance and benefits of ReliOn's modular fuel cell-based backup power solutions on a critical application for the Department of Homeland Security, U.S. Border Patrol at Mica Peak, near Spokane, Washington.

2.0 Name, Address and Related Company Information

ReliOn, Inc.
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(509) 228-6500

DUNS #: 137264193
CAGE Code: 3K7Y7
TIN: 912191190

ReliOn, Inc., a privately held, small business, headquartered in Spokane, Washington, manufactures and markets proton exchange membrane (PEM) fuel cell products based on a unique and patented modular design. The company's current focus is on the sale and installation of highly reliable backup power solutions for critical applications within the telecom, utility and government/military markets.

ReliOn's offering helps customers increase network reliability while reducing overall equipment life-cycle costs in stationary, low power applications, typically requiring 200 watts to 5 kilowatts. Our air-cooled, self-hydrating fuel cells are highly reliable because we require only a minimal balance of plant and are able to bypass potential failure points.

ReliOn, formerly Avista Labs, has been developing, demonstrating and marketing PEM fuel cell technology for the past ten years.

3.0 Production Capability of the Manufacturer

ReliOn, Inc., as described above, will be the supplier and integrator of the primary products that comprise the backup power solution. These products are the I-1000's, 1kW fuel cell systems, and the Outdoor Enclosure System which is designed to house the fuel cells, hydrogen fuel and fuel delivery system. ReliOn will oversee the complete installation and commissioning of the backup power solution as well as address all maintenance requirements via company applications engineers.

I-1000 Fuel Cell models and Outdoor Enclosure Systems are commercially available today. ReliOn's fuel cells are made from common materials using mature manufacturing processes in injection molded plastic, sheet metal fabrication and printed circuit board assembly. The membrane electrode assemblies (MEA) are purchased through a supply agreement with 3M.

ReliOn has two contract manufacturers—Servatron producing circuit boards and control system subassemblies, and Logan Industries for final fuel cell assembly and integration

into the Outdoor Enclosure system. Both of these firms are located within a 3 mile radius of ReliOn headquarters in Spokane, Washington, allowing easy interface and rapid problem solving. Production capacity is approximately 500 I-1000 fuel cells and 250 Outdoor Enclosure systems in 2005. These outputs are expected to double in 2006.

The Outdoor Enclosure Systems to be installed U.S. Border Patrol communication sites will be assembled and checked out in ReliOn's manufacturing area at its Spokane headquarters. This will allow integration and operational verification of special test instrumentation used in the CERL demonstration program.

4.0 Principal Investigator(s)

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5.0 Authorized Negotiator(s)

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Mr. Joe Blanchard
Senior Director Product Line Management
ReliOn, Inc.
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6.0 Past Relevant Performance Information

ReliOn currently has more than 200 fuel cell systems installed and operational in commercial applications covering 4 continents. Our fuel cell systems and backup power solutions have achieved numerous safety and performance certifications including; CSA, CE and NEBS Level III (telecom).

Our experience is inclusive of the following installations:

- **The Federal Aviation Administration;**
  - Palwaukee, IL, Radio Transmitter Receiver, December, 2003
  - Swinns Valley, WI, Microwave, June, 2004
  - Wakeman, OH, Microwave, August, 2004
  - Fargo, ND, RCAG, September, 2004
  - Average turn-key cost was approximately $35,000
  - Contacts; Mr. Stanley Lee, General Engineer, 847-294-8457; stanley.lee@faa.gov
    Mr. Steve Aldridge, Environmental Engineer, 952-997-9264; steve.aldridge@faa.gov

- **The Bureau of Reclamation;**
  - Loveland, CO, Microwave, October, 2003
  - System cost was approximately $15,000
  - Contact; Mr. Nathan Myers, Electrical Engineer, 303-445-2633 nmyers@do.usbr.gov

- **The States of Maryland and Ohio;**
  - 2 Sites in MD, 4 Sites in OH
  - E-911 radio equipment, August 2003 to October, 2004
  - Average turn-key cost was approximately $30,000 (no outdoor enclosure)
  - Contact; Mr. George Milne, COO, havePOWER, 202-299-0506 gmilne@havepower.com

In addition, ReliOn Fuel Cell Systems are installed in commercial deployment as well as in field trials with the following customers:

- Verizon Wireless
- Sprint
- Bahamas Telecommunications (BATELCO)
- Centennial Wireless
- Tricom
- Puerto Rico Telecom (PRTC)

7.0 Host Site Information

Key contact personnel at the U.S. Border Patrol are as follows:

Mr. Lesley Coburn
U.S. Customs and Border Protection
(406) 452-8028
lesley.coburn@dhs.gov

Mr. John Gunnoe
Assistant Chief
U.S. Border Patrol
(202) 344-1799
john.gunnoe@dhs.gov

Site 1--Mica Peak, near Spokane, Washington:

The Mica Peak microwave and radio repeater station is located approximately 25 miles southeast of Spokane, Washington. The Mica Peak station is at an elevation of 5225 feet. This site contains 10 GE and Motorola radios, all powered with 110/120 VAC from the grid. The total power draw by these radios while on transmit status is about 5860 Watt. Average transmit duty is 10-15%. The Border Patrol has future plans to add 5 more radios to the site, however the schedule for these additions has not been developed. There is also a plan to replace of all of the radios with new designs operating at lower power consumption, and at 12 VDC. Again, schedules have not been defined for these replacements. The modular design of the ReliOn fuel cell will allow for straightforward accommodation of load changes once the 12 month test period has concluded.

The station also includes a Monitron remote surveillance sensor and two (2) microwave repeaters with a constant draw of 4.25 Amps each at 24 VDC. These repeaters are powered from an existing 24 VDC lead-acid battery string. The batteries are charged from a 25 Amp/24 Volt rectifier with a float voltage of 27.2 V. The Mica Peak station also has an existing 5 kW propane generator for site back-up power. The Border Patrol has indicated that they plan to remove the propane generator from service as soon as the fuel cell system is commissioned at this site.

Site 2--Sector Office Site – Spokane, Washington

The Border Patrol maintains a 100 Watt microwave repeater station and two (2) GE Hi Band radio base stations at the Sector Headquarters building located at 10710 N. Newport Highway in Spokane. Currently, only one radio is in use. The second radio has been switched off and is being held in reserve. The Spokane Sector Headquarters is at an elevation of 1230 feet. The two (2) microwave repeaters with a constant draw of 4.25 Amps each at 24 VDC. These repeaters are powered from an existing 24 VDC lead-acid battery string. The batteries are charged from a 25 Amp/24 Volt rectifier with a float

voltage of 27.2 V. The radio base stations are powered directly from the commercial grid at 110/120 VAC and draw 560 W each on transmit. Average transmit duty is 10-15%. There is no back-up generator at the station.

8.0 Description of Project

Our objective is to provide backup power solutions for critical microwave repeater and radio equipment sites that are key to the network of the Spokane, Washington Sector Office of the U.S. Border Patrol.

The sites to be powered in this project are:

Site 1: Mica Peak, Washington Repeater Station
Site 2: Spokane Sector Headquarters Microwave and Radio Transmitter Station

ReliOn is supplying turn-key fuel cell packages that will enhance network reliability and extend backup runtime capacity at these sites protecting the northern U.S. border. These turn-key packages are incorporating ReliOn's air cooled, modular fuel cells operating in a grid-independent mode. The fuel cell systems are being configured to monitor the commercial AC power grid as well as the status of the existing DC backup batteries at each site. Upon loss or failure of either power source, the fuel cells will start automatically to provide up to 96 kWh of continuous run power to critical surveillance and communication equipment at the U.S. Border Patrol sites. In addition to providing continuous protection from a primary power failure, the installation is designed to simulate a power failure in the AC grid each day. This daily test will provide an extensive record of reliability, availability, and performance data as the fuel cell serves the critical equipment load over the proposed 12 month program. At each site, the 1 kW fuel cell modules will be ganged together in 2kW to 3kW configurations to meet the maximum load requirements and provide added redundancy. Because ReliOn's fuel cells operate at a relatively low temperature, cogeneration will not be a part of this operation. Fuel switching will not be required as the I-1000 runs on standard industrial grade hydrogen (99.95% purity), which is readily available.

The ReliOn fuel cell system will be in an off, but ready state (standby) the majority of the time. The ReliOn solution is designed to recognize a loss (or simulated loss) of primary power and start up instantaneously to provide power to the load on the DC bus as well as continued maintenance of battery charge. We will simulate a power outage everyday and run the system for a 60-minute time period in order to test the availability of the fuel cell system. This test program will serve as a stringent test of fuel cell system reliability, particularly during the winter months when access to the Mica Peak mountain top site will be challenging.

A programmable logic controller (PLC) is being installed with each system to simulate the grid outage by opening a relay to cut AC power to both the rectifier/charger and the grid sensing circuit in the fuel cell enclosure. The PLC will also monitor the run status of

the fuel cells and will reconnect AC power to the rectifier should there be any type of operational failure that jeopardizes the U.S. Border Patrol equipment.

For remote monitoring, a data-logging computer will be placed in the adjacent communications equipment shelter. The computer will be connected to the measurement and monitoring equipment in the Outdoor Enclosure through a local area network (LAN). Data will be collected concerning total operating hours, the number of actual starts versus attempted starts from "system-standby" mode, equipment loads, kilowatt hours produced, voltage levels, fuel consumption, fuel pressure, ambient temperature, humidity, and maintenance logs. If the system fails to start up properly or provide required power to the load, this event will be noted in the logs as a failure and count against the 90% availability of the system.

In addition to basic equipment load, fuel cell system performance, and environmental data, ReliOn proposes the first field demonstration of a new methodology to continuously monitor PEM fuel cell membrane hydration state. The technique, developed by ReliOn, is known as ESR/Vr and is based on simultaneous measurements of cell equivalent series resistance (ESR) and voltage recovery (Vr) during ReliOn's patented, millisecond duration cell shunt cycles. ReliOn implemented cell shunting with its first generation PEM fuel cells in order achieve a self-humidifying system that could be installed and operated without external hydration of the incoming air and fuel streams. Through accurate measurements of ESR/Vr, ReliOn is perfecting control algorithms to continuously adjust cell shunting in order to precisely control membrane hydration levels. This process provides an optimum PEM membrane operating state with the added benefits further improving net fuel cell efficiency and extending membrane life.

The data from the data-logging computer will be downloaded to a server at ReliOn by remote dial-up after each system test run. The data logging computer will also have an alarm notification utility that will automatically dial preprogrammed phone numbers to notify ReliOn personnel of any alarm condition. One telephone line will be used for remote monitoring at each site.

The ReliOn I-1000 is a system based on removable cartridges that house the PEM membranes. If a membrane fails, the system will take the cartridge with the failed membrane offline while it continues to provide power to the load. This situation will trigger a minor alarm and the system will provide a visual indication as well as remote notification of this status. When it is convenient, the failed cartridge can be replaced. This task can be accomplished in less than one minute without the use of tools.

When testing is complete, the fuel cell, enclosure and composite concrete pad at each site can easily be removed and returned to ReliOn or the end user can elect to have the site retrofitted for commercial operation.

Site 1--Mica Peak, near Spokane, Washington:

The Mica Peak repeater station is shown in Figure 1. This site contains 10 GE and Motorola radios, two (2) microwave repeaters, and a Monitron remote surveillance sensor. The radio and microwave equipment is shown in Figure 2 and the Monitron sensor is shown in Figure 3. We are installing a 3 kW fuel cell enclosure equipped with four (4) hydrogen storage compartments to provide 96 kW-h of nominal runtime. The location for the enclosure is adjacent to the site equipment shelter as illustrated in Figure 4.

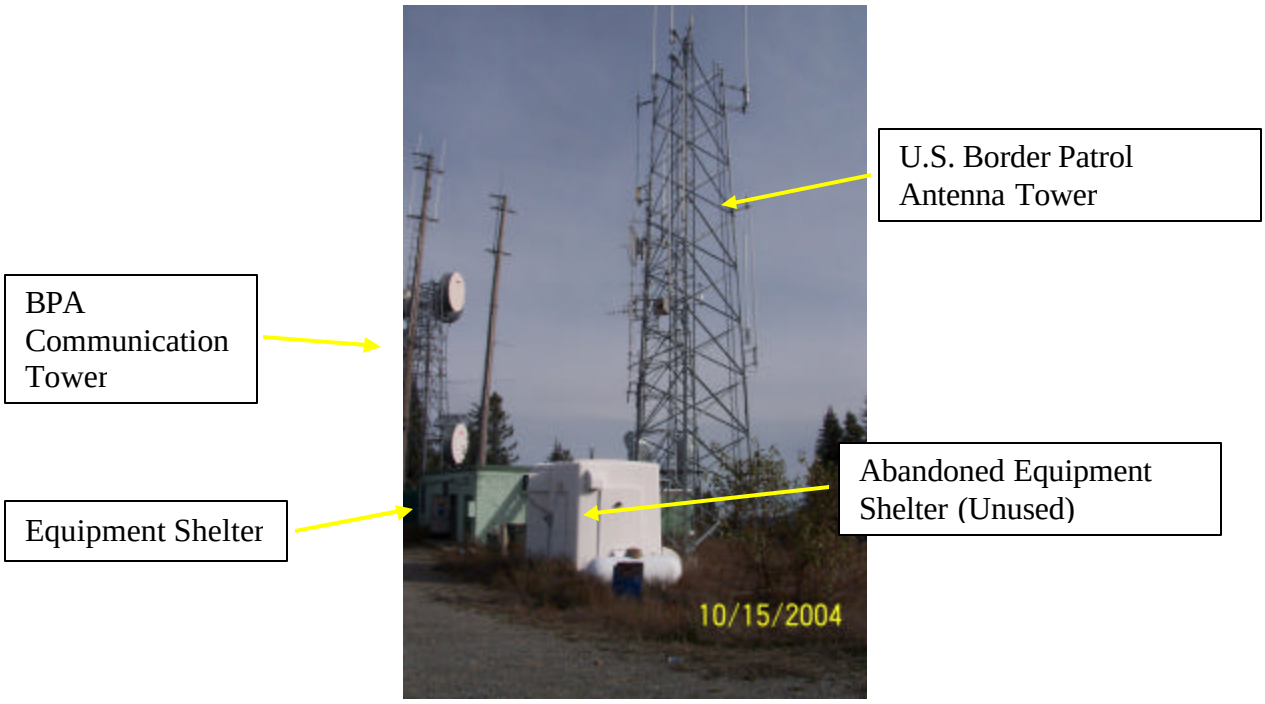

Figure 1. U.S. Border Patrol Mica Peak Repeater Station

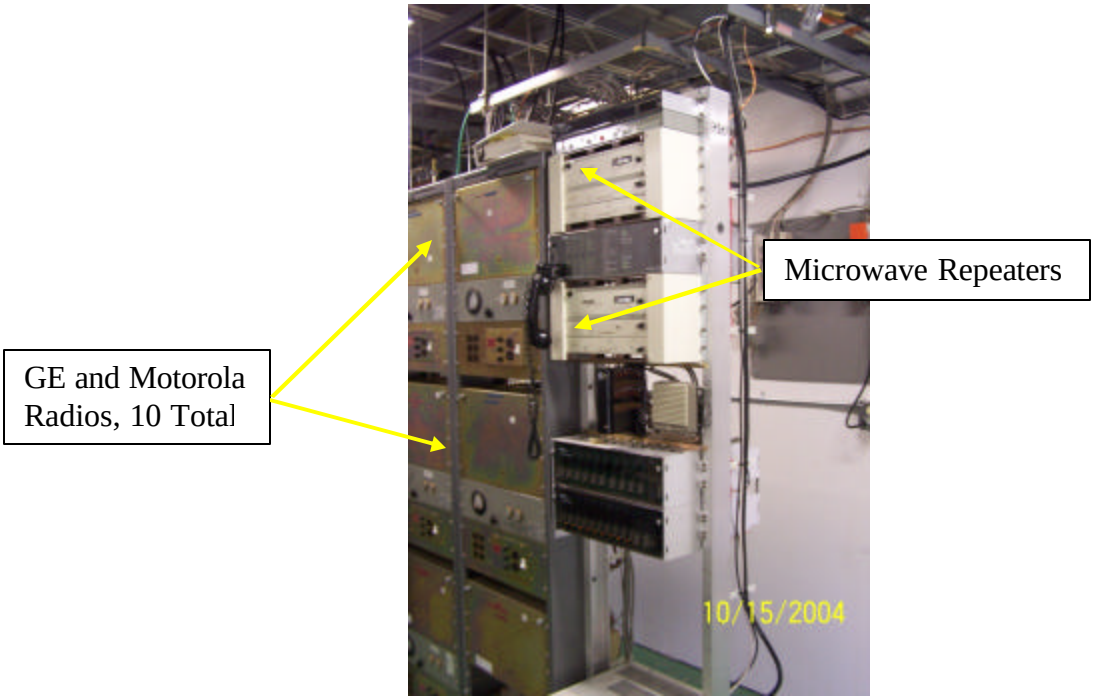

Figure 2. Microwave and Radio Repeaters Mica Peak Washington Repeater Station

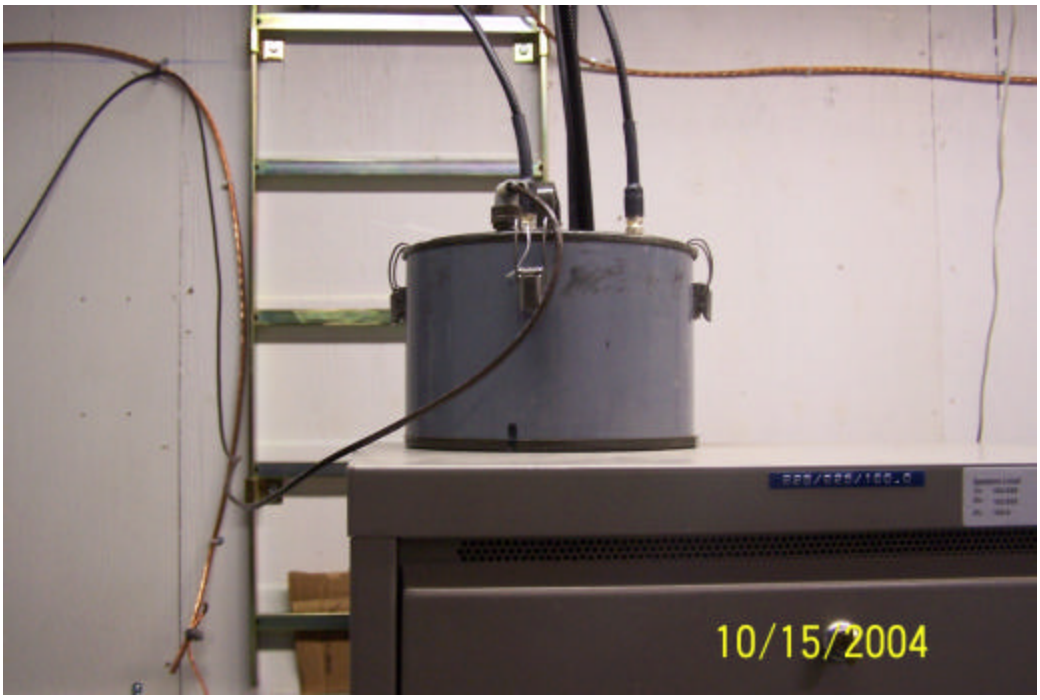

Figure 3. Monitron (600 mA at 12 VDC)
Mica Peak Washington Repeater Station

Figure 4. Proposed Fuel Cell Enclosure Location
Mica Peak Washington Repeater Station

To integrate our fuel cell solution with the equipment at Mica Peak, the fuel cells will be connected to the existing 24 VDC battery bank in the equipment shelter, shown in Figure 6. A new 24 VDC/120 VAC inverter will be installed to power the radios from the 24 V battery bank. This will require a larger 24 V rectifier/charger which will also be installed in the project. The microwave and Monitron sensor are currently supplied with DC power. Under this plan, primary power from the existing AC supply will maintain a float charge on the DC bus through the rectifier/chargers. All critical equipment at each site will be powered by the DC bus which will also be directly backed up by the ReliOn fuel cells. The existing propane engine generator at the site will be removed from service following fuel cell system commissioning.

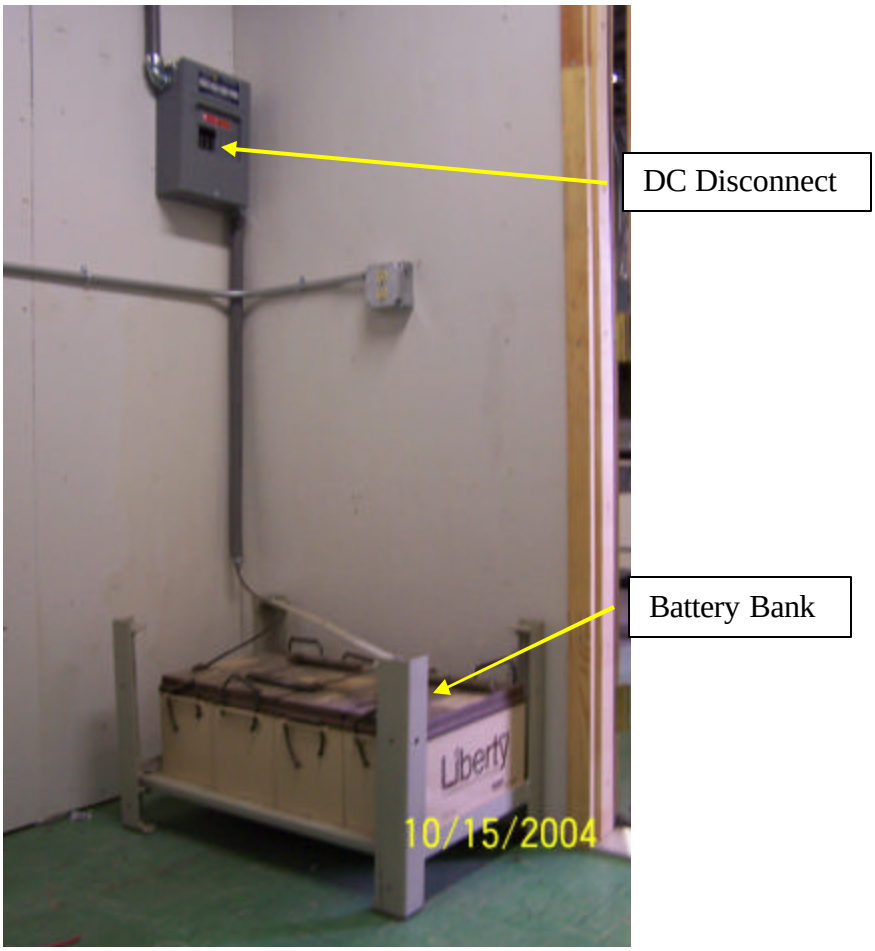

Figure 6. Existing 24 VDC Battery Bank
Mica Peak Washington Repeater Station

Assuming 20% radio transmit duty, and an inverter efficiency of about 75%, the 10 radios, two microwaves, and the Monitron sensor will require a total average power supply of 1730 Watt. This requirement will be provided with the 3 kW Outdoor Enclosure system. Load calculations for this site are presented in Table 1.

Table 1. Fuel Cell Load Calculations
Mica Peak Repeater Station

Site 1--Mica Peak Station
Option B: Install DC – AC Inverter

Existing Rectifier: Power Conversion Products
Part No. FE-24-2513
Nameplate Rating: 25 Amp @ 24 VDC
Float Voltage: 27.2 VDC
Nominal Average Load: 7.5 Amp

Existing Battery Bank: Liberty Battery, 24 VDC String
Part No. LS6-200
Nameplate Rating: 210 Amp-hr @ 6 VDC (Ea)

New Rectifier ==> 100 Amp @ 24 VDC
New Inverter Efficiency = 75%

System Usage ==> **Nominal Average**

Device	Quantity	Equipment Power Draw (Each)	Duty Cycle	Total Power at 24 VDC (Watt)	Total Current at 24 VDC (Amp)
Microwave Repeaters	2	4.5 Amp @ 24 VDC	100%	216	9.0
GE Hi Band Base Station Radio	6	560 W @ 110 VAC	20%	896	37.3
GE Mastr II Base Station Radio	1	625 W @ 110 VAC	20%	149	6.2
Motorola Quantar Base Station Radio	1	625 W @ 110 VAC	20%	149	6.2
Motorola MSF 5000 Base Station Radio	2	625 W @ 110 VAC	20%	299	12.4
Monitron Sensor	1	600 mA @ 16 VDC	100%	13	0.5
			Total	**1722**	**71.8**

Maximum battery bank run time to low limit cutoff voltage

DC Bus Low Limit Cutoff (VDC @ 1.75 V per cell) = **21**

	Min	**Hr**
Run Time to Fuel Cell Auto Start at 24 VDC =	**50.9**	**0.8**
Run Time to Low Limit Cutoff =	**114.3**	**1.9**

System Usage ==> **Estimated Maximum**

Device	Quantity	Equipment Power Draw (Each)	Duty Cycle	Power (Watt)	Total Current at 24 VDC (Amp)
Microwave Repeaters	2	4.5 Amp @ 24 VDC	100%	216	9.0
GE Hi Band Base Station Radio	6	560 W @ 110 VAC	40%	1792	74.7
GE Mastr II Base Station Radio	1	625 W @ 110 VAC	40%	299	12.4
Motorola Quantar Base Station Radio	1	625 W @ 110 VAC	40%	299	12.4
Motorola MSF 5000 Base Station Radio	2	625 W @ 110 VAC	40%	597	24.9
Monitron Sensor	1	600 mA @ 16 VDC	100%	13	0.5
			Total	**3215**	**134.0**

Maximum battery bank run time to low limit cutoff voltage

DC Bus Low Limit Cutoff (VDC @ 1.75 V per cell) = **21**

	Min	**Hr**
Run Time to Fuel Cell Auto Start at 24 VDC =	**17.3**	**0.3**
Run Time to Low Limit Cutoff =	**45.5**	**0.8**

Subject to final approval by U.S. Border Patrol personnel, we anticipate scheduling the simulated power outage at approximately 2:00 PM each day. This timing will allow site personnel (if available) to observe the test and does not interfere with data transmission from other sites to ReliOn's data server.

On-Site maintenance will be minimal, consisting primarily of leak checks, visual inspections, and special test runs. With the fuel cell enclosure configured with four (4) hydrogen storage compartments the nominal runtime will be 40 to 45 hours at the expected average equipment load. Therefore we expect to replenish hydrogen fuel supplies at the site approximately every 5 to 6 weeks depending on the extent of special test runs and duration of commercial grid outages. Although the Mica Peak site is a remote mountain top location, the access road is well-maintained and kept open year around except for short-term periods during the most severe winter storms.

Site 2--Spokane Sector Headquarters Microwave and Radio Transmitter Station

The Spokane Sector Headquarters Station is shown in Figure 7. This site contains two (2) GE Hi Band radio base stations and two (2) microwave repeaters. Currently, only one radio is in use. The second radio has been switched off and is being held in reserve. The radio and microwave equipment is shown in Figure 8. We propose to install a 2 kW fuel cell enclosure equipped with two (2) hydrogen storage compartments to provide 48 kW-h of nominal runtime. The planned location for the enclosure is adjacent to the site equipment shelter as illustrated in Figure 9.

To integrate our fuel cell solution with the equipment at the Sector HQ station, the fuel cells will be connected to the existing 24 VDC battery bank in the equipment shelter. Similar to the Mica Peak installation, a new 24 VDC/120 VAC inverter will be installed to power the radios form the 24 V battery bank. The existing 24 V rectifier/charger is rated at 25 Amps and is sufficient to support this load. The microwave is currently supplied with DC power. Under this plan, primary power from the existing AC supply will maintain a float charge on the DC bus through the rectifier/chargers. All critical equipment at each site will be powered by the DC bus which will also be directly backed up by the ReliOn fuel cells.

Assuming 20% radio transmit duty, and an inverter efficiency of about 75%, the radios, microwave repeaters, and Monitron sensor would require a power supply of about 520 Watts. Although this could be provided with a single 1 kW fuel cell, a 2 kW system in the Outdoor Enclosure will be used for added redundancy. Load calculations for this site are presented in Table 2.

Table 2. Fuel Cell Load Calculations
Spokane Sector Station

Site 2--Spokane Sector HQ Communications
Option B: Install DC – AC Inverter

Existing Rectifier: Power Conversion Products
Part No. FE-24-2513
Nameplate Rating: 25 Amp @ 24 VDC
Float Voltage: 27.2 VDC
Nominal Average Load: 7.5 Amp

Existing Battery Bank: Liberty Battery, 24 VDC String
Part No. LS6-200
Nameplate Rating: 210 Amp-hr @ 6 VDC (Ea)

New Inverter Efficiency = 75%

System Usage ==> **Nominal Average**

Device	Quantity	Equipment Power Draw (Each)	Duty Cycle	Power (Watt)	Total Current at 24 VDC (Amp)
Microwave Repeaters	2	4.5 Amp @ 24 VDC	100%	216	9.0
GE Hi Band Base Station Radio	2	560 W @ 110 VAC	20%	299	12.4
			Total	**514.7**	**21.4**

Maximum battery bank run time to low limit cutoff voltage

DC Bus Low Limit Cutoff (VDC @ 1.75 V per cell) = **21**

	Min	**Hr**
Run Time to Fuel Cell Auto Start at 24 VDC =	**410.5**	**6.8**
Run Time to Low Limit Cutoff =	**677.8**	**11.3**

System Usage ==> **Estimated Maximum**

Device	Quantity	Equipment Power Draw (Each)	Duty Cycle	Power (Watt)	Total Current at 24 VDC (Amp)
Microwave Repeaters	2	4.5 Amp @ 24 VDC	100%	216	9.0
GE Hi Band Base Station Radio	2	560 W @ 110 VAC	40%	597	24.9
			Total	**813.3**	**33.9**

Maximum battery bank run time to low limit cutoff voltage

DC Bus Low Limit Cutoff (VDC @ 1.75 V per cell) = **21**

	Min	**Hr**
Run Time to Fuel Cell Auto Start at 24 VDC =	**186.2**	**3.1**
Run Time to Low Limit Cutoff =	**345.3**	**5.8**

Subject to final approval by U.S. Border Patrol personnel, we anticipate scheduling the simulated power outage at approximately 3:00 PM each day. This timing will allow site personnel (if available) to observe the test and does not interfere with data transmission from other sites to ReliOn's data server.

As with the Mica Peak site, maintenance at the Spokane Sector Headquarters will be minimal, consisting primarily of leak checks, visual inspections, and special test runs. With the fuel cell enclosure configured with two (2) hydrogen storage compartments the nominal runtime will be about 96 hours at the expected average equipment load. Therefore we expect to replenish hydrogen fuel supplies at the site approximately every 8 to 10 weeks depending on the extent of special test runs and duration of commercial grid outages.

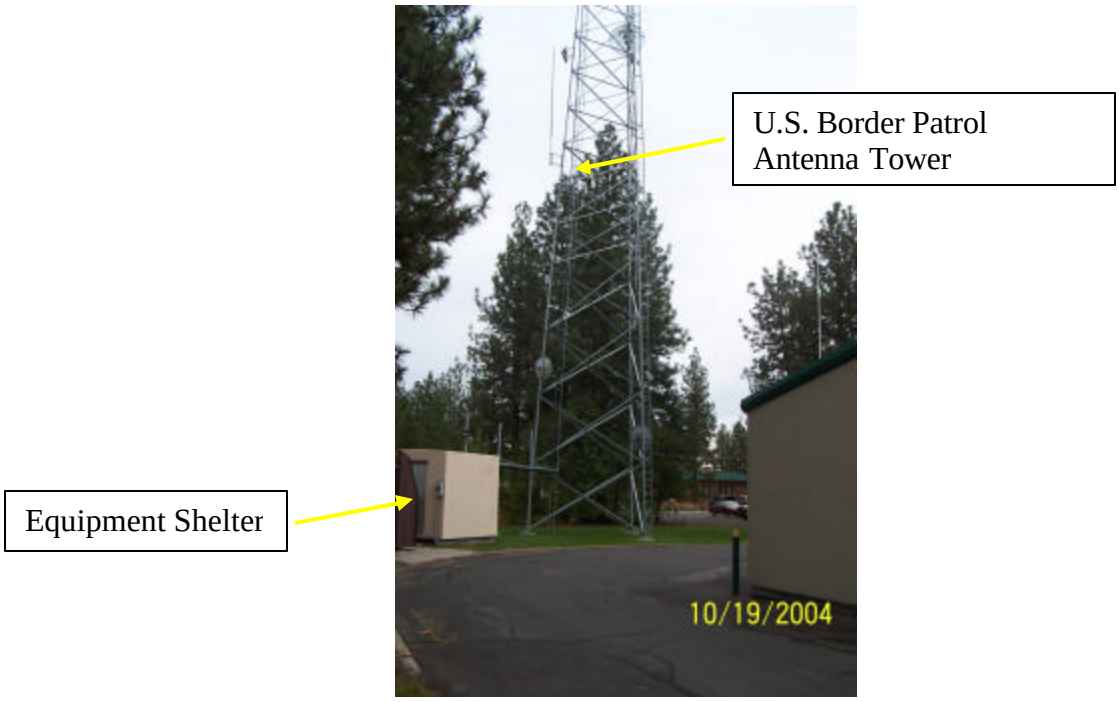

Figure 7. U.S. Border Patrol Spokane Sector Station

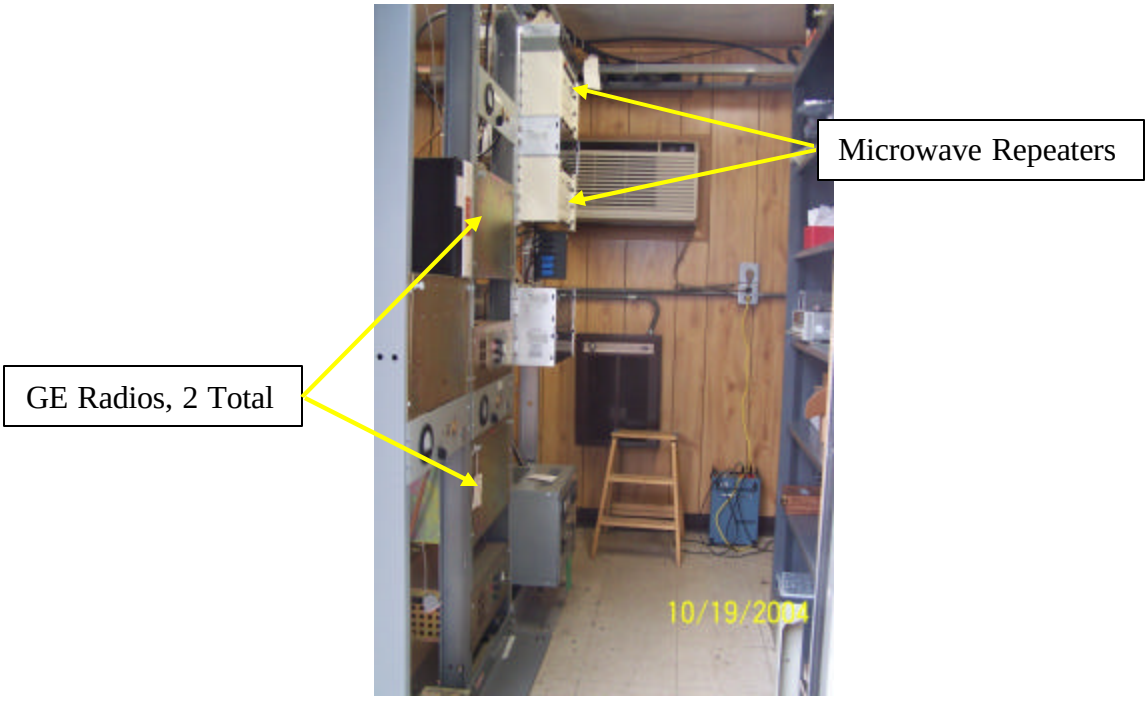

Figure 8. Microwave and Radio Repeaters Spokane Sector Station

Figure 9. Proposed Fuel Cell Enclosure Location
Spokane Sector Station

9.0 Electrical System

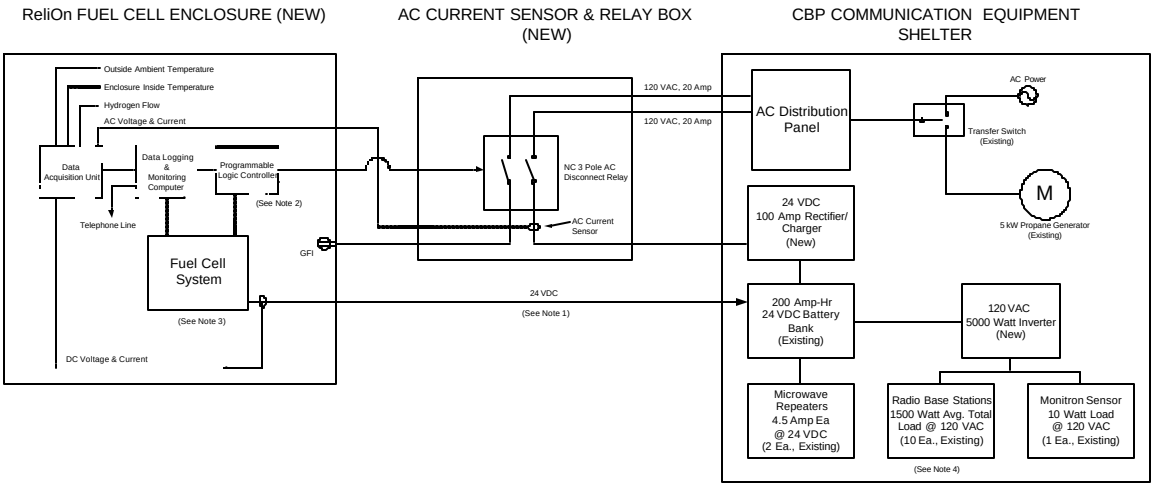

Figure 10. Functional Block Diagram
Mica Peak Repeater Station

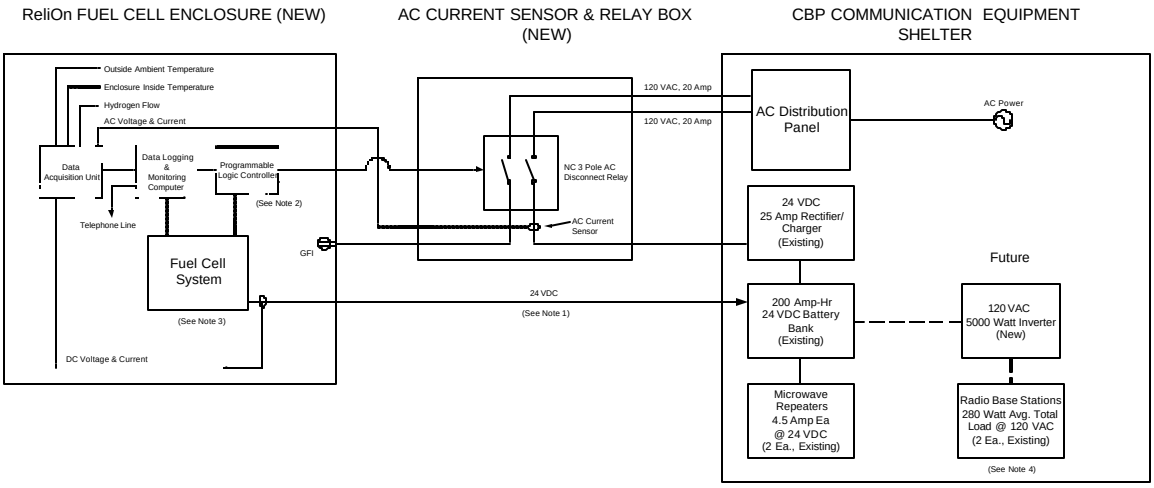

Figure 11. Functional Block Diagram
Spokane Sector Station

The fuel cell systems will run in a grid-independent mode and require no special transfer switch or synchronization equipment. The system will be in a standby/ready mode to provide backup power for critical DC equipment when there is a loss of primary AC power or low DC bus voltage. Electrical and communication connections between the fuel cell enclosures and the communications shelters will be through dedicated conduit runs. The following connections will be required for the installation:

Electrical Requirements:

- One 15 – 20 Amp circuit required at each site for AC monitoring and to provide power for the enclosure heater when the fuel cells are not running and the ambient temperature is below 10^{o}C (50^{o}F). The heater is designed to keep the environment around the fuel cell above freezing to facilitate startup. Once the fuel is running, it utilizes its own heat for operation.
- AC disconnect relay between AC power and the existing site rectifier/charger.
- The fuel cell enclosure will be grounded using code-conforming practice by connecting to existing ground system or with a new ground stake located adjacent to the enclosure. Ground connection between the enclosure and ground will be made using a 1/0 AWG bare copper ground cable and a clamp or other approved connection compatible with local code and practice for equipment grounding.
- DC connection between fuel cell system and DC bus in customer's equipment cabinet
- All electrical work to be completed by a Contract Licensed Electrician

Telephone Lines:

- One phone line required for data monitoring and system control
- Commercial telephone service for the phone line, provided by ReliOn

- One computer with dial-up capability at each site, provided by ReliOn

10.0 Thermal Recovery System

Not applicable.

11.0 Data Acquisition System

A programmable logic controller (PLC) will be installed with each system to simulate the grid outage by opening a relay to cut AC power to both the rectifier/charger and the grid sensing circuit in the fuel cell enclosure. The PLC will also monitor the run status of the fuel cells and will reconnect AC power to the rectifier should there be any type of operational failure that jeopardizes the U.S. Border Patrol equipment.

For remote monitoring, a data-logging computer will be placed in the adjacent communications equipment shelter. The computer will be connected to the measurement and monitoring equipment in the Outdoor Enclosure through a local area network (LAN). Data will be collected concerning total operating hours, the number of actual starts versus attempted starts from "system-standby" mode, equipment loads, kilowatt hours produced, voltage levels, fuel consumption, fuel pressure, ambient temperature, humidity, and maintenance logs. If the system fails to start up properly or provide required power to the load, this event will be noted in the logs as a failure and count against the 90% availability of the system.

In addition to basic equipment load, fuel cell system performance, and environmental data, ReliOn proposes the first field demonstration of a new methodology to continuously monitor PEM fuel cell membrane hydration state. The technique, developed by ReliOn, is known as ESR/Vr and is based on simultaneous measurements of cell equivalent series resistance (ESR) and voltage recovery (Vr) during ReliOn's patented, millisecond duration cell shunt cycles. ReliOn implemented cell shunting with its first generation PEM fuel cells in order achieve a self-humidifying system that could be installed and operated without external hydration of the incoming air and fuel streams. Through accurate measurements of ESR/Vr, ReliOn is perfecting control algorithms to continuously adjust cell shunting in order to precisely control membrane hydration levels. This process provides an optimum PEM membrane operating state with the added benefits further improving net fuel cell efficiency and extending membrane life.

The data from the data-logging computer will be downloaded to a server at ReliOn by remote dial-up after each system test run. The data logging computer will also have an alarm notification utility that will automatically dial preprogrammed phone numbers to notify ReliOn personnel of any alarm condition. One telephone line will be used for remote monitoring at each site.

12.0 Economic Analysis

ReliOn fuel cell systems provide secure, reliable, and economically attractive back up power solutions to communication, control, security, and other critical equipment. Currently, we are marketing a range of stationary fuel cells for emergency and back up power requirements, uninterruptible power supplies, digital power needs and a variety of critical off grid power requirements. We serve private and public entities as diverse as telecommunications, energy, transportation, and government.

Our hydrogen fuel cells are designed to run on industrial grade bottled hydrogen or some other substantially pure hydrogen source. The primary benefit to the customer or end user is the ability to extend emergency or back up run times substantially beyond run times available from conventional battery-based systems. Additional benefits beyond extended run times are small space requirements, low noise signature, zero emissions, and no hazardous material or special disposal requirements. An example economic analysis is presented in Appendix I showing comparisons with conventional battery systems to provide a 24 hour back up run time for equipment averaging 1 kW of power draw.

13.0 Kickoff Meeting Information

Completed on June 8, 2005.

14.0 Status/Timeline

Completed Event	Target Date
Kickoff Meeting	8 June
Finalize System Configurations	10 June
Procure Special Test & Data Monitoring Equipment	15 June
Draft Initial Project Description Report	17 June
Construction Drawings Completed	17 June
Select Subcontractors	24 June
Site Preparation	15 July
Install systems	5 August
System Startup and Acceptance Testing	12 August
Performance Report	(Monthly following startup)
Draft Midpoint Project Status Report	15 September
Acceptance Test Meeting	22 September
Project Demonstration Completed	1 September 2006
Turnover/restoration	3rd Quarter 2006
Draft Final Report	29 September 2006